A Scientific Beta Publication

Scientific Beta
An EDHEC-Risk Institute Venture

What Really Explains the Poor Performance of Factor Strategies over the Last 3 years?

September 2019

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Abstract

Contrary to what has been affirmed without any really serious study or even rigorous empirical observations, the poor performances of multi-factor indices or solutions are not the result of a strong and abnormal deterioration in factor performances. One can certainly observe that some factors have experienced significant underperformance, but it has been possible to offset this with the performances of other factors. Ultimately, the average risk premium of the consensual six long/short market-neutral factors remains positive.

The main explanation for the underperformance of long-only factor indices and solutions relates more to the implementation choices of the factor exposures than to the factors themselves. In a long-only framework, index and strategy design rarely takes account of the non-factor risks induced by the factor exposure choices. Among these risks, as we have documented in many research publications, the market beta risk or gap, which often corresponds to an unstable and defensive bias in the construction of factor strategies, is the one that has the most impact over the long term in terms of both the return and volatility of these strategies.

In the last 3 years, the non-control of market beta exposure in a bull market context has prevented factor indices from benefitting fully from the important market risk premium. It is this poor market conditionality rather than the variations in factor returns that explains the disappointing performance of long-only factor offerings over the past 3 years.

About the Authors

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Introduction: What are the Drivers of the Performance of Factor Strategies?

A Scientific Beta Publication — What Really Explains the Poor Performance of Factor Strategies over the Last 3 years? — September 2019

Introduction: What are the Drivers of the Performance of Factor Strategies?

Factor strategies have been experiencing disappointing performance for the last 3 years from June 2016 to June 2019. This performance has led many practitioners to call into question the very usefulness of solutions based on factor diversification. The objective of this document is to respond to criticism that is often based on assertions that have not been proven empirically, are not supported by serious academic research and ignore the very nature of factor strategies' performance drivers.

The performance of factor strategies is based on three main elements:
i) Exposure to rewarded factors. While there are a large number of risk factors that can explain the variation in a stock or a portfolio of stocks' returns over a period, there is a very limited number of factors that are considered to be rewarded in the sense that they not only have explanatory power over the variations in returns, but also explain the cross-sectional differences in returns of stocks or portfolios of stocks. These factors have been identified by academic research as being six in number, namely the Value, Momentum, Size, Low Volatility, High Profitability and Low Investment factors. The final two factors are often called Quality factors[1].
ii) Good diversification of unrewarded idiosyncratic risk. Academic research since the seminal work of Harry Markowitz has constantly considered that it is important for investors to strongly reduce idiosyncratic risk, i.e. the risk that is specific to each stock and that does not correspond to exposure to a systematic factor, because these idiosyncratic risks are not rewarded. The usual way of diversifying this unrewarded risk in modern portfolio theory and construction is to diversify it. In several research publications, we have shown that for an equivalent level of exposure to a given factor, i.e. for the same beta, the risk-adjusted performance was much better in the case of a well-diversified portfolio or factor index[2]. Diversification of a factor portfolio's specific risk allows the risk premia to be captured more efficiently.
iii) The third element that has a strong impact on the performance of factor strategies is the management of systematic, non-factor risks. These risks are the undesired or implicit consequences of explicit choices of factor exposures or weighting schemes. Indeed, since risk factors are never orthogonal with other forms of risks, especially in a long-only approach, it is clear that factor choices have sector consequences and can even modify the market exposure through the nature of some long-only factors, like Low Volatility for example. When these implicit risk choices are not anticipated and controlled, they have significant consequences for the risk and performance profiles of factor strategies and can lead to strong differences in performance and risk for the same choice of factors over a given period. In many publications in recent years, we have underlined the importance of taking account of these risks.[3]

Unfortunately, even though these performance drivers have been the subject of many publications, one cannot but notice that in many comments that have accompanied the disappointing performance of factor strategies over the last 3 years, they have been mainly ignored in favour of highly-sample-dependent anecdotes and explanations that tend not to be based on rigorous observations.

1 - For more information on these factors, please consult "Long-Term Rewarded Equity Factors: What Can Investors Learn from Academic Research?" Fall 2016, *Journal of Index Investing*; "Smart Beta And Beyond: Maximising The Benefits Of Factor Investing," February 2018, EDHEC Risk Institute Publication supported by Amundi; and "A Guide to Scientific Beta Multi-Smart Factor Indices" December 2018, Scientific Beta White Paper.
2 - "Towards Smart Equity Factor Indices: Harvesting Risk Premia without Taking Unrewarded Risks" Summer 2014, *Journal of Portfolio Management*; "Diversified or Concentrated Factor Tilts?" Winter 2016, *Journal of Portfolio Management*.
3 - "Misconceptions and Mis-selling in Smart Beta: Improving the Risk Conversation in the Smart Beta Space," June 2019, Scientific Beta White Paper; "Adding Value with Factor Indices: Sound Design Choices and Explicit Risk-Control Options Matter," March 2019, Scientific Beta White Paper.

Introduction: What are the Drivers of the Performance of Factor Strategies?

For the vast majority of the commentators on the performance on factor solutions, the main cause is supposed to be that the exposure to long-term rewarded factors had negative consequences due to the underperformance of these factors. Some of the reasons mentioned as a major cause of factor underperformance were the fact that some rewarded factors were no longer really rewarded (the case of the Size factor) or that certain academic factor definitions were no longer appropriate (the case of the Value factor) or indeed that the negative performance of factors was due to a crowding effect related to the very popularity of factor investing.

Unfortunately, this work does not hold up against the rigour of an even remotely serious investigation into the phenomena mentioned.

As far as the crowding effect is concerned, serious studies on the subject based on measuring the impact of the rebalancing of factor strategies show that there is no real effect and that it can be limited even further when one is diversified, as is the case as part of a multi-factor approach that is based on factor proxies that themselves are varied.

On the subject of the Size factor, the Scientific Beta research team published a study recently showing that in spite of a smaller premium than in the past, the Size factor still has an important role in the factor menu and contributes positively to the improvement in the risk-adjusted performance of multi-factor strategies.[4]

Concerning the Value factor, there is no clear evidence that the consensual academic proxy, Book-to-Market, is dominated by other proxies. Attempts to search for better proxies on the basis of recent performance (i.e. in-sample optimisation), give very disappointing out-of-sample results. In addition, we feel it is important to recall that the appropriate proxy for the Value factor is not a valuation proxy, as claimed by many practitioners, but a proxy that allows the cost or risk of the irreversibility of investments to be measured. It is the irreversibility of investments that justifies this factor's premium and from this perspective the choice of Book-to-Market finds its justification fairly intuitively. Finally, and above all, it should be observed that the focus on the sole criterion for selecting Value stocks to construct a long-only factor index neglects essential methodological elements, which are diversification of idiosyncratic risk and the protection of factor intensity. Taking these dimensions into account has a largely positive and much more important impact than the choice of a criterion for selecting Value stocks.

In fact, these anecdotes and wrong arguments have turned investors' attention away from the essential elements that not only explain the recent performance of factor strategies but also explain the diversity of the performance. Indeed, contrary to what is written just about everywhere, it is not so much the factors that have contributed to the disappointing performance as the conditions in which the investment in factors has been implemented. In fact, as we show in this paper, it is not the factors, but the non-factor risks that are the source of the disappointing performance in the last 3 years.

4 - For more details on this subject, please refer to the white paper "Does the Size Factor Still Have its Place in Multi-Factor Portfolios?" July 2019, Scientific Beta Publication.

Introduction: What are the Drivers of the Performance of Factor Strategies?

The plan that we follow to support our statement is fairly straightforward. We first analyse and contrast the performance of factors over the last 3 years and over a long-term period as well as their consequences for the performance of a long-only multi-factor portfolio. Finally, we show the very simple impact of controlling or not controlling the non-factor risk to which all factor strategies are exposed, namely the market beta risk, on the performances of these same factor portfolios.

1. Performances and Contribution of the Factors

1. Performances and Contribution of the Factors

1.1 Comparison Between the Performances over the Last 3 years and the Factors' Long-Term Performance

Over the last 3 years, for the six Long/Short factors, we observe in Exhibit 1 that for the US universe, three factors performed negatively, namely Size, Value and Momentum, and delivered much worse than the average negative performance observed since inception (21-Jun-2002). For Momentum, this performance is even below its worst 5% 3-year rolling returns. For Value, the performance is slightly above the worst 5% and for Size, the loss is close to the average of negative performance. On the Developed ex-US universe the observation is similar with three factors that underperformed. However, only Low Investment posted negative performance that is lower than the average negative performance since inception and close to its worst 5% performance.

Exhibit 1 – Performance of L/S factors over the last 3 years (Jun-2016 to Jun-2019) and since inception
We use daily total returns from 21-Jun-2002 to 30-Jun-2019 on SciBeta US, Developed Ex-US. Currency is USD for SciBeta US and Developed Ex-US. All statistics are calculated on a rolling basis over a 3-year window size, with a one-month step size. Average 3-year rolling returns denotes the mean of the 3-year rolling return time-series of each factor. Average 3-Year rolling negative returns denotes the mean of negative 3-year rolling return time-series of each factor. Worst 5% 3-year rolling return is the fifth percentile of the 3-year rolling returns time-series of each factor. For Average return below worst 5% returns, we compute the average of all returns, which are below the worst 5% 3-year rolling returns for each factor. Maximum 3-Year rolling loss is the worst 3-year rolling performance over the full sample. The Market factor is the difference in return of the cap-weighted index of all stocks that constitute the index portfolio and the risk-free rate. The Size factor is the return series of an equal-weighted portfolio that is long small market-cap stocks and short the top 30% stocks (large market-cap stocks) sorted on market capitalisation in descending order. The Value factor is the return series of an equal-weighted portfolio that is long for the top 30% stocks (value stocks) and short for the bottom 30% stocks (growth stocks) sorted on book-to-market value in descending order. The Momentum factor is the return series of an equal-weighted portfolio that is long the winner stocks and short the loser stocks. The winner stocks (inversely the loser stocks) are defined as the top 30% (inversely the bottom 30%) of stocks, sorted on the past 104 weeks' compounded returns excluding the most recent month, in descending order. The Volatility factor is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low volatility stocks) and short the top 30% stocks (high volatility stocks) sorted on past volatility in descending order. The Profitability factor is the return series of an equal-weighted portfolio that is long the top 30% stocks (high profitability stocks) and short the bottom 30% stocks (low profitability stocks) sorted on gross profitability in descending order. The Investment factor is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low investment stocks) and short the top 30% stocks (high investment stocks) sorted on two year asset growth in descending order. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter.

	SMB	HML	MOM	VOL	PRO	INV
	SciBeta US					
Last 3-Year (Jun-2016 to Jun-2019)						
Return	-3.25%	-5.49%	-5.37%	10.56%	6.17%	0.71%
Volatility	8.06%	6.04%	9.59%	9.88%	5.67%	4.08%
Rolling 3-Year statistics (since inception)						
Average 3-Y rolling returns	0.32%	1.13%	0.22%	7.32%	2.71%	1.62%
Average 3-Y rolling negative returns	-2.58%	-3.44%	-2.99%	-1.07%	-4.54%	-2.06%
Worst 5% 3-Y rolling returns	-6.10%	-5.82%	-5.29%	-0.54%	-6.07%	-3.26%
Average return below worst 5% returns	-7.05%	-6.48%	-6.92%	-1.84%	-6.40%	-3.73%
Max 3-Y rolling loss	-8.60%	-7.02%	-9.24%	-3.83%	-7.88%	-4.04%
	SciBeta Developed Ex-US					
Last 3-Year (Jun-2016 to Jun-2019)						
Return	3.49%	-2.69%	-0.37%	2.15%	0.93%	-1.09%
Volatility	5.00%	5.38%	6.63%	6.21%	3.83%	3.18%
Rolling 3-Year statistics (since inception)						
Average 3-Y rolling returns	7.47%	2.05%	5.33%	7.27%	3.42%	0.89%
Average 3-Y rolling negative returns	-3.70%	-3.50%	-2.00%	N/A	-1.13%	-0.79%
Worst 5% 3-Y rolling returns	-5.97%	-5.39%	-2.79%	1.28%	-2.12%	-1.18%
Average return below worst 5% returns	-8.78%	-5.74%	-4.42%	0.87%	-2.27%	-1.71%
Max 3-Y rolling loss	-10.60%	-6.36%	-7.55%	0.21%	-2.43%	-2.46%

1. Performances and Contribution of the Factors

The first question that arises with regard to these results, especially for the US region, is whether the level of underperformance over the three-year period is unprecedented or whether this type of underperformance can be found in the history of factor performance. Exhibit 2 allows the performance of the same six factors to be compared over a long-term track record available on US data (40-year US Long-Term Track Record (LTTR) for the years 1977-2017). We observe that the underperforming factors Size, Value and Momentum have non-null probabilities of 25.1%, 37.1% and 30.6% respectively, which means that the phenomenon observed over the last 3 years is not abnormal and is even fairly frequent. This corresponds to the very nature of a priced risk factor, which is characterised by the cyclicality of its returns through time.

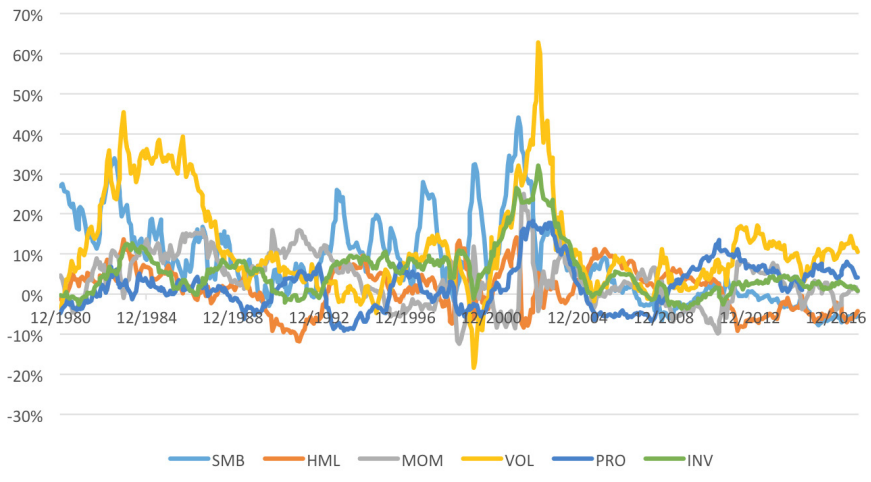
Exhibit 2 – Performance of L/S factors on US LTTR over 40 years (1977 to 2017)
We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) for the EDHEC-Risk US LTTR universe. L/S factors are defined as in Exhibit 1. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. All measures are calculated on a rolling basis over a 3-year window size, with a one-month step size. Average 3-year rolling returns denotes the mean of the 3-year rolling return time-series of each factor. Average 3-Year rolling negative returns denotes the mean of negative 3-year rolling return time-series of each factor. We compute the probability of negative 3-year rolling returns by dividing the number of negative occurrences by the total number of observations.

	SMB	HML	MOM	VOL	PRO	INV
Average 3-Y rolling returns	8.13%	1.26%	3.43%	11.74%	1.94%	5.46%
Average 3-Y rolling negative returns	-3.14%	-4.54%	-3.88%	-3.52%	-3.78%	-1.36%
Probability of negative 3-Y rolling returns	25.05%	37.06%	30.64%	7.87%	36.85%	15.32%

We conducted a more detailed analysis of the cyclicality of factor risk premium on US LTTR, because this is the only universe for which we have long-term data[5], and the variations can be quite strong, as we observe in Figure 1. Some factors can experience huge performance swings. For instance, the Low Volatility factor (VOL) delivered tremendous performance in the aftermath of the dotcom bubble but this period was preceded by its worst 3-year rolling returns over the full sample.

Figure 1 – 3-year rolling window performance of L/S factors on US LTTR over 40 years (1977 to 2017)
We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) for the EDHEC-Risk US LTTR universe. L/S factors are defined as in Exhibit 2. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. 3-year rolling performances are calculated on a rolling basis over a 3-year window size, with a one-month step size

Figure 1 – 3-year rolling window performance of L/S factors on US LTTR over 40 years (1977 to 2017)



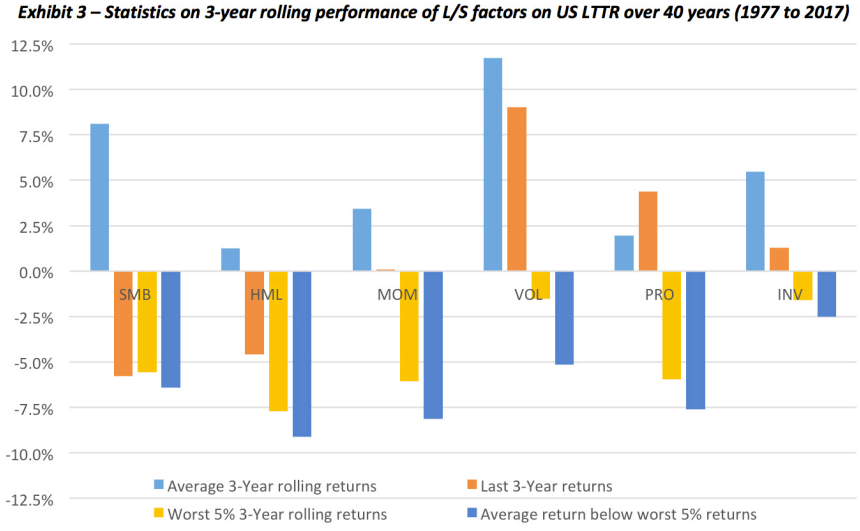
5 - As part of its research on the cyclicality of factors, Scientific Beta is constructing Developed, Europe and Japan LTTRs that will be available by the end of 2019.

1. Performances and Contribution of the Factors

In the next paragraphs, we analyse more closely the distribution of 3-year rolling returns, since L/S factor returns can experience extended periods of negative performance. In Exhibit 3, we show 3-year rolling statistics on the six L/S factors. First, we emphasise that they all delivered positive returns over the long-term, ranging from 1.26% for the Value factor (HML) to a tremendous 11.74% for the Low Volatility factor (VOL). These results are consistent with numerous findings in the academic literature, which has shown that these factors are important for explaining the cross-sectional variation of stock returns and provide a robust risk premium. However, these average returns provide only partial information on the distributional properties of returns, since they do not give any sense of extreme performance. Indeed, investors care about unexpected events or performance in the left tail of the distribution of returns. In this spirit, we computed the "3-year rolling returns – worst 5%" measure. The latter can be compared to a Value at Risk (VaR) measure, that is, what is the loss of a given L/S factor in the 5% worst-case scenario over a 3-year horizon. We stress that these numbers can be quite large, since across all factors, the average is close to -5% and ranges from -1.52% for Low Volatility (VOL) to -7.73% for Value (HML).

To go beyond the VaR and measure how much investors can lose below the 5% threshold, we introduce the next measure, which is called "Average return below worst 5% 3-year rolling returns." This measure is similar to a Conditional Value at Risk (CVaR). It enables the average loss over the 3-year horizon that investors can expect in extreme cases to be evaluated. We highlight that the Low Volatility factor (VOL) has a huge conditional loss of -5.13% compared to the VaR-type measure, which was only -1.52%. Overall, the CVaR-type measure ranges from -2.52% for Low Investment (INV) to -9.12% for Value (HML).

Exhibit 3 – Statistics on 3-year rolling performance of L/S factors on US LTTR over 40 years (1977 to 2017)
We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) for the EDHEC-Risk US LTTR universe. L/S factors are defined as in Exhibit 1. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. All measures are calculated on a rolling basis over a 3-year window size, with a one-month step size. Average 3-year rolling returns denote the mean of the 3-year rolling return time-series of each factor. Worst 5% 3-year rolling return is the fifth percentile of the 3-year rolling returns time-series of each factor. For Average return below worst 5% returns, we compute the average of all returns, which are below the worst 5% 3-year rolling returns for each factor.



1. Performances and Contribution of the Factors

Exhibit 4 – Summary of statistics on negative long-term performance for L/S factors on US LTTR over 40 years (1977 to 2017)
We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) for the EDHEC-Risk US LTTR universe. L/S factors are defined as in Exhibit 1. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. All measures are calculated on a rolling basis over a 3-year window size, with a one-month step size. We compute the probability of negative 3-year rolling returns by dividing the number of negative occurrences by the total number of observations. Worst 5% 3-year rolling return is the fifth percentile of the 3-year rolling returns time-series of each factor. For Average return below worst 5% returns, we compute the average of all returns, which are below the worst 5% 3-year rolling returns for each factor. Maximum 3-year rolling loss is the worst 3-year rolling performance over the full sample. Time to recover worst 5% return is the number of months it took to recover from breaking the 5% worst 3-year rolling returns.

	SMB	HML	MOM	VOL	PRO	INV
Probability of negative 3-Y rolling returns	25.05%	37.06%	30.64%	7.87%	36.85%	15.32%
Worst 5% 3-Y rolling returns	-5.58%	-7.73%	-6.06%	-1.52%	-5.95%	-1.58%
Average return below worst 5% returns	-6.41%	-9.12%	-8.12%	-5.13%	-7.60%	-2.52%
Maximum 3-Y rolling loss	-7.78%	-11.82%	-12.40%	-18.39%	-9.14%	-3.65%
Time to recover from worst 5% returns	26	38	20	6	33	12

In Exhibit 4, which provides a summary of the extreme loss analyses, we show a complementary measure, namely the "Probability of negative 3-year rolling returns," which gives an appreciation of how often a L/S factor experiences a negative 3-year rolling performance and the average time to restore positive performance. We underline that L/S factors have a non-null probability of delivering negative returns over a 3-year horizon. Low Volatility (VOL) has the lowest probability (7.87%) and Value (HML) has the highest probability (37.06%), with an average across all factors of roughly 25%. This number is far from being marginal and therefore, we should not be surprised to see L/S factors underperforming over a 3-year period.

We emphasize that the performance of Size, Value and Momentum factors over the last 3 years on the SciBeta universe is not as extreme when compared to long-term observations based on LTTR universe, since it stands above their respective VaR-type measure. Finally, we highlight that the average time to recover from breaking the VaR-type measure is dramatically different across L/S factors. Indeed, it can take between 6 months for Low Volatility (VOL) to as much as 38 months for Value (HML). Based on these numbers, we can infer that it could still take 28 months or slightly more than two years for the Value factor to deliver positive 3-year rolling performance and 20 months for the Momentum factor. Here again, the recent duration of underperformance of some L/S factors recorded over the last 3 years is not exceptional and should be put in perspective in the light of statistics of time to recover from extreme performance observed over the long-term.

Naturally, one of the objectives and advantages of multi-factor indices or funds is to rely on factors whose performances are strongly decorrelated, as shown in the following table (Exhibit 5). This decorrelation should reduce the probability that several factors underperform simultaneously with the number of concerned factors.

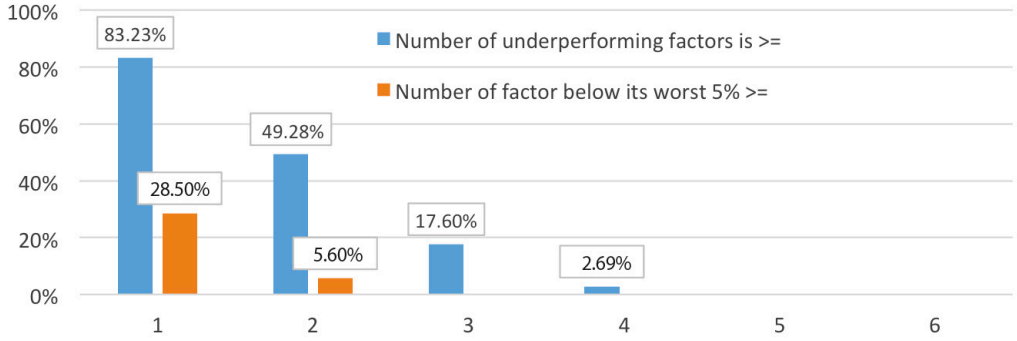
1. Performances and Contribution of the Factors

Exhibit 5 – Average correlation of the six L/S factors on US LTTR over 40 years (1977 to 2017)
The exhibit displays the average correlation between the six market beta neutral L/S factors as defined in Exhibit 1. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) from the EDHEC-Risk US LTTR universe. The average correlation for one L/S factor, is the average correlation it has with the other L/S factors.

US LTTR	SMB	HML	MOM	VOL	PRO	INV
Average correlation	-0.09	-0.09	-0.19	0.07	-0.12	0.09

It is important to be able to check whether the fact that three factors experienced negative performance is an abnormal phenomenon that would indicate that the fundamentals of factor diversification are no longer relevant, or whether this phenomenon has already been observed in the history of factor performance. To check this point, we computed in Exhibit 6 the probabilities of simultaneously having several L/S factors with negative 3-year rolling performance. We observe that for more than 83% of months, we have at least one factor underperforming over a 3-year horizon. Almost half of the time, we have at least two factors underperforming. This probability falls to 18% for three factors, which is what happened over the last 3 years with Size, Value and Momentum, to less than 3% for four factors and to zero for five or more factors.

Exhibit 6 – Probability of negative 3-year rolling performance for several L/S factors simultaneously and probability of having several factors with a 3-year rolling performance below its worst 5% value on US LTTR over 40 years (1977 to 2017)
The exhibit displays the probability that at least 1 out of 6 factors, 2 out of 6 factors … and 6 out of 6 factors underperform in the same month based on 3-year rolling returns. We use daily total returns from 31-Dec-1977 to 31-Dec-2017 (40 years) from the EDHEC-Risk US LTTR universe. We compute rolling returns over a 3-year window size, with a one-month step size. Among the six factors are Size, Value, Momentum, Low Volatility, High Profitability and Low Investment. L/S factors are constructed as in Exhibit 1. All factors considered are market beta neutralised quarterly using ex-post CAPM beta over the quarter. We compute the probabilities by dividing the number of occurrences where at least 1, 2 … or 6 factors underperform simultaneously, by the total number of observations.



To conclude on the subject of factor performance, we can simply observe that the negative performance of the last 3 years, in terms of both its value and its frequency, is absolutely not abnormal and in no way constitutes a reason to call the premia associated with these factors into question.

1.2 Macroeconomic Conditionality

Average correlation is nonetheless a poor measure for analysing conditional correlations. Only a conditional correlation analysis provides an understanding of the economic drivers of the variations in risk premia observed and which can result in serious underperformance of multi-factor strategies

1. Performances and Contribution of the Factors

over the long run, even if these are highly decorrelated on average over the long term. Considering conditional correlations allows one to analyse and evaluate the limitations of the approaches in terms of simple deconcentration or factor diversification. Investors need to account for conditional correlations explicitly to analyse risks along the relevant macroeconomic dimensions, which go beyond a simple classification of bull and bear markets. Understanding macroeconomic risks is a prerequisite both for risk transparency and for improving diversification of equity factor investments. Scientific Beta published a paper this year, "A Framework for Assessing Macroeconomic Risk in Equity Factors"[6] documenting that equity risk factors show dependencies on the news related to economic conditions. In particular, this research showed that there is a significant contemporaneous relationship between factor returns and innovations (unexpected changes) in state variables that react quickly to news relating to economic conditions.

These variables are based on market prices and incorporate expectations about future economic fundamental measures, such as growth and inflation. For this note, we use five different macroeconomic state variables:
i. Short interest rate: reflects the level of the term structure of interest rates
ii. Term spread: reflects the slope of the term structure of interest rates
iii. Default spread: reflects risk compensation in corporate bond markets
iv. Aggregate Dividend yield: reflects risk compensation in the stock market
v. Systematic volatility: reflects the level of stock market risk

Exhibit 7 reports spreads that are the difference between annual returns in periods corresponding to "positive surprises" to the state variable (the top 25%), and in periods corresponding to "negative surprises" to the state variable (the worst 25%). For example, we can see that the Low Volatility (VOL) premium was around 30 percentage points lower when short-term interest rates unexpectedly increased, compared to times when the opposite happened. This difference is both statistically and economically significant, and is consistent with the "bond-like" characteristic of low volatility stocks.

Exhibit 7 – Macro spreads of L/S factors to state variables on US LTTR over 40 years (1977 to 2017)
*The exhibit reports macro spreads, defined as the difference between the annualised geometric mean returns of equity factors when innovations in state variables were in the highest and lowest quartiles. Innovations come from VAR(1) model, and are orthogonalised to the market excess returns. Significance based on Welch's t-test at the 10%, 5% and 1% levels are indicated by *, ** and ***, respectively. The results are based on monthly data from December-1977 to December-2017. Data source: Scientific Beta, CRSP, FED of St. Louis.*

	SMB	HML	MOM	VOL	PRO	INV
Short-rates	6.8	-4.2	4.1	-24.3**	7.4*	-8.0**
Term spread	-2.5	14.7**	-18.5***	-2.8	-3.3	5.5*
Default spread	-12.5	-5.6	10.5	15.7	6.3	1.6
Dividend yield	-41.4***	-0.3	-5.5	-1.6	-2	-2.6
Systematic Volatility	-11.6	-3	-0.1	6.2	1.6	0.3

We also find that the Value (HML) factor favours a positive surprise to the term spread, since it performs significantly better when term spread increases. This is in line with the idea that Value

6 - Amenc, N., M. Esakia, F. Goltz, and B. Luyten, May 2019, "A Framework for Assessing Macroeconomic Risk in Equity Factors", Scientific Beta White Paper.

1. Performances and Contribution of the Factors

firms have lower duration than growth firms, which makes them less sensitive to changes in the slope of the yield curve. The Size factor (SMB) is particularly exposed to negative shocks to the Dividend Yield. Note that when there is an increase in the dividend yield state variable, this is not due to market returns (since the state variable is neutralised from market returns), but due to higher expected returns. This means that the Size factor will react poorly to increases in expected returns and vice versa. In general, we see that all factors show high sensitivity to at least one state variable. Having seen that factors are significantly exposed to the state variables, we can also analyse the macro dependency from a broader perspective. We aggregate single state variables into composite macro indicators, which aim to capture expectations regarding future economic activity. We define the macro-outlook as a linear combination of state variables, using the weights that reflect how each of them predict future economic growth[7]. Exhibit 8 reports annualised returns when macro-indicators experienced highly positive or highly negative shocks. The final row computes the difference between the two.

Exhibit 8 – Macro spreads of L/S factors to the Macro outlook on US LTTR over 40 years (1977 to 2017)
The macro-outlook measure is a weighted average of five state variables. The weights are proportional to the loadings (coefficients) from the linear predictive regression, where we try to explain future 1-year growth in industrial production index using 1-year lagged state variables. The innovation in macro-outlook is defined as weighted-average innovation in single state variables. The predictive regression is based on long-term data, between 12/1977 and 12/2016. The results below are based on innovations in macro-outlook. Calendar months when innovation in macro-outlook was in the highest (lowest) quartile is classified as good times (bad times).

	SMB	HML	MOM	VOL	PRO	INV
Good times (positive outlook)	17	10.4	-7.4	7.7	1.3	7.9
Bad times (negative outlook)	0.9	-4	5.4	19.1	5.3	3.5
Macro Outlook spread	16.1*	14.4***	-12.8**	-11.4	-3.9	4.4

The results from Exhibit 8 indicate that the Size and Value factors performed significantly better in "good times." Momentum experienced the opposite dependency on the macro outlook. The annualised spread for Momentum was negative about 13 percentage points, which is slightly lower than that of the Size and Value factor in terms of the magnitude. The spreads for the Low Volatility, High Profitability and Low Investment factors were not statistically significant. Nevertheless, the Low Volatility factor performed about 11 percentage points better during the bad times. The spreads were lower for the Profitability and Investment factors.

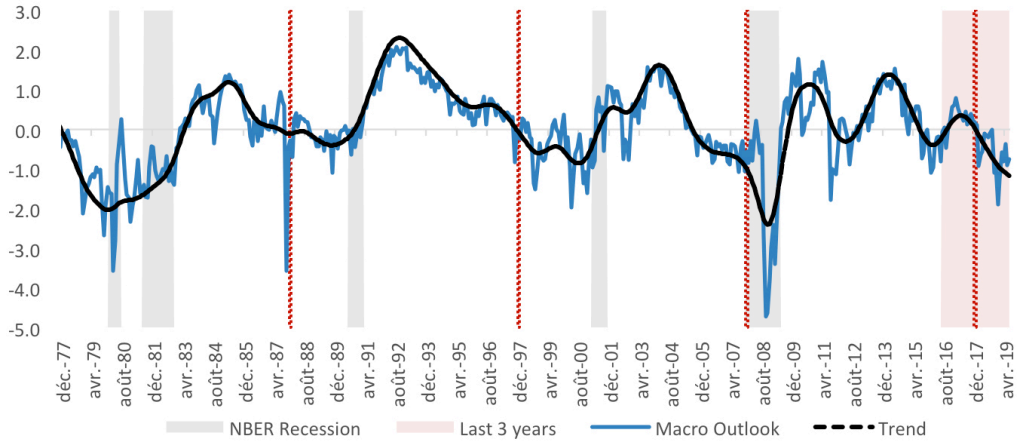
We can now move forward and assess macroeconomic regimes historically, and more importantly over the recent period. Figure 2 plots the macro-outlook indicator along with NBER recession dates shaded in grey. Vertical lines in red split the long-term records into four ten-year periods, while the last 3 years are shaded in red. We also add a smoothened macro-outlook indicator to better identify the direction (trend) of the macroeconomic outlook.

We can see from the plot that all recessions were preceded by some decline in macro outlook. Note that there were two recessions during the first ten-year period. Despite that, the macro outlook was increasing for about 6-years (from 1979 to 1985). This is one of the possible reasons why Size and Value, two factors that are positively related to macro-outlook, generated stellar returns compared to their long-term average.

7 - The macro-outlook measure is the weighted average of five state variables. The weights are proportional to the loadings (coefficients) from the linear predictive regression, where we try to explain future 1-year growth in industrial production index using 1-year lagged state variables. The innovation in macro-outlook is similarly defined by weighting the innovation in single state variables by the same weights. The predictive regression is run on long-term data, between 12/1977 and 12/2016. Note that we stop at the end of 2016 since taking 1-year ahead growth exhausts our sample until 2017.

1. Performances and Contribution of the Factors

Figure 2 – Aggregate indicator of Macro Outlook
Smoothing is done using the Hodrick-Prescott filter. The penalty for trend component (lambda) was set to 500.



If we look at the last 3 years, we can see that the macro outlook experienced mostly negative shocks. This is also noticeable if we look at the trend component. Hence, we can assume that the recent underperformance of the Size and Value factors is partly driven by negative surprises to the macro outlook. The strong performance of Low Volatility and Profitability is also in line with their negative sensitivity to the macro outlook.

It is also interesting to compare the most recent outlook to the historical values. The current trend is quite similar to the one in late 1990s, right before the "dot-bubble". Interestingly, the end of the 20th century was also a tough period for the Size and Value factors, similar to what we have seen in the last 3 years. It is possible that the two factors are undergoing the same regime as in the late 1990s.

From these macroeconomic analyses, we can affirm that the strong negative variations in the risk premia observed in recent years are consistent with the risk premia's performance drivers. Here again, the consistency between the historical and recent periods tends to confirm that there is no reason to call into question the consensual 6-factor menu. Moreover, at each variation in a risk premium, which is inherent in its existence, since the variation in its premium is what characterises a risk, it would be time for alpha sellers to stop calling into question smart beta, which is not alpha, but just a cost-efficient way to collect alternative risk premia. Investors, and the investment industry more generally, would gain from a distinction being made between alpha, which is a constant, the disappearance of which means an increase in the efficiency of the market and a reduction in the possibility of exploiting mispricing, and the normal rewards (or factor premia) associated with portfolio betas.

1.3 Contribution of Factor Exposures to the Performance of Long-Only Multi-Factors

With three factors out of six having produced negative performance over the last 3 years, it is expected that the analysis of the contribution of the factors as part of a multi-factor strategy will give mixed results. We have therefore constructed single factor indices by using cap-weighted indices and adding a market-neutral long/short overlay and have then built a multi-factor construction

1. Performances and Contribution of the Factors

by aggregating these single long-only factor sleeves in the form of an equal-weighted six-factor index. In Exhibit 9, we find the previous results again, namely that three out of six single long-only factors underperformed the broad cap-weighted index in the US region, and also three out of six in the Developed ex-US region over the last 3 years. Nonetheless, if we take account of a perfect equal-weighted index, we observe that in both the US and Developed ex-US regions, this long-only factor construction outperformed the cap-weighted index over the last 3 years, admittedly to a lesser extent than over 15 years (0.51% compared to 2.45% annual relative return for the US region and 0.55% compared to 3.73% for Developed ex-US), but contrary to what is said here and there, a pure multi-factor construction provided positive performance in the last 3 years. It is therefore not so much the factors that are to blame in the performance but the construction choices of the multi-factor indices or portfolios offered by the providers. Among these design choices, some are fairly constrained by the long-only regulatory framework of many funds or institutional investors. It is often difficult to set up pure factor strategies due to the inability to implement long/short strategies and the construction of long-only indices through the use of long/short overlays is difficult. Other choices correspond more to a lack of consideration of non-factor risks in the design of the index, where it involves documenting this risk in order to then manage it properly. In the next section of this paper, we will see that it is the lack of integration of the main non-factor risk that is the cause of the disappointment with factor strategies.

Exhibit 9 – Performance comparison, cap-weighted index and market-neutral long/short factors
The analysis is based on daily USD total returns data from 30-Jun-2016 to 30-Jun-2019 for the last 3 years. CW is the SciBeta USA Cap-Weighted index. All strategies are constructed as follow: 100% in the CW index and 100% in the corresponding market neutral L/S factors. L/S factors are market beta neutralised using quarterly ex-post realised market betas. The Size factor (SMB) is the return series of an equal-weighted portfolio that is long small market-cap stocks and short the top 30% stocks (large market-cap stocks) sorted on market capitalisation in descending order. The Value factor (HML) is the return series of an equal-weighted portfolio that is long for the top 30% stocks (value stocks) and short for the bottom 30% stocks (growth stocks) sorted on book-to-market value in descending order. The Momentum factor (MOM) is the return series of an equal-weighted portfolio that is long the winner stocks and short the loser stocks. The winner stocks (inversely the loser stocks) are defined as the top 30% (inversely the bottom 30%) of stocks, sorted on the past 104 weeks' compounded returns excluding the most recent month, in descending order. The Volatility factor (VOL) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low volatility stocks) and short the top 30% stocks (high volatility stocks) sorted on past volatility in descending order. The Profitability factor (PRO) is the return series of an equal-weighted portfolio that is long the top 30% stocks (high profitability stocks) and short the bottom 30% stocks (low profitability stocks) sorted on gross profitability in descending order. The Investment factor (INV) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low investment stocks) and short the top 30% stocks (high investment stocks) sorted on two year asset growth in descending order.

Last 3 years, US region

From 2016-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	14.38%	10.31%	8.08%	7.96%	25.82%	21.47%	15.06%	14.89%
Volatility	12.27%	14.75%	13.75%	15.52%	15.71%	13.48%	12.98%	12.46%
Sharpe Ratio	1.06	0.60	0.48	0.42	1.55	1.49	1.05	1.08
Max Drawdown	19.41%	29.53%	26.24%	21.40%	16.56%	15.56%	22.42%	20.91%
Relative Performance								
Relative Return Over CW	-	-4.06%	-6.29%	-6.42%	11.45%	7.09%	0.68%	0.51%
Tracking-Error	-	8.05%	6.05%	9.59%	9.84%	5.67%	4.07%	2.05%
Information Ratio	-	N/A	N/A	N/A	1.16	1.25	0.17	0.25
Max Relative Drawdown	-	24.32%	25.38%	23.61%	13.98%	7.65%	7.21%	2.82%

1. Performances and Contribution of the Factors

Last 3 years, Dev ex-US

From 2016-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	9.57%	13.42%	6.69%	9.09%	11.84%	10.73%	8.27%	10.12%
Volatility	9.58%	10.86%	10.94%	11.69%	11.43%	10.34%	10.08%	9.71%
Sharpe Ratio	0.85	1.10	0.48	0.66	0.91	0.90	0.68	0.90
Max Drawdown	20.58%	23.15%	25.35%	19.26%	15.24%	18.95%	23.64%	20.53%
Relative Performance								
Relative Return Over CW	-	3.84%	-2.88%	-0.49%	2.26%	1.16%	-1.30%	0.55%
Tracking-Error	-	5.00%	5.38%	6.63%	6.22%	3.83%	3.17%	1.48%
Information Ratio	-	0.77	N/A	N/A	0.36	0.30	N/A	0.37
Max Relative Drawdown	-	5.78%	22.59%	17.95%	15.07%	7.02%	8.03%	3.21%

*The analysis is based on daily USD total returns data from 30-Jun-2004 to 30-Jun-2019 for the last 15 years. CW is the SciBeta USA Cap-Weighted index. All strategies are constructed as follow: 100% in the CW index and 100% in the corresponding market neutral L/S factors. L/S factors are market beta neutralised using quarterly ex-post realised market betas. The Size factor (SMB) is the return series of an equal-weighted portfolio that is long small market-cap stocks and short the top 30% stocks (large market-cap stocks) sorted on market capitalisation in descending order. The Value factor (HML) is the return series of an equal-weighted portfolio that is long for the top 30% stocks (value stocks) and short for the bottom 30% stocks (growth stocks) sorted on book-to-market value in descending order. The Momentum factor (MOM) is the return series of an equal-weighted portfolio that is long the winner stocks and short the loser stocks. The winner stocks (inversely the loser stocks) are defined as the top 30% (inversely the bottom 30%) of stocks, sorted on the past 104 weeks' compounded returns excluding the most recent month, in descending order. The Volatility factor (VOL) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low volatility stocks) and short the top 30% stocks (high volatility stocks) sorted on past volatility in descending order. The Profitability factor (PRO) is the return series of an equal-weighted portfolio that is long the top 30% stocks (high profitability stocks) and short the bottom 30% stocks (low profitability stocks) sorted on gross profitability in descending order. The Investment factor (INV) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low investment stocks) and short the top 30% stocks (high investment stocks) sorted on two year asset growth in descending order. Bull and bear markets are defined based on the CW index monthly returns. Positive (negative) monthly CW returns define bull (bear) regimes. Bull (Bear) relative returns is the relative return over the CW index of the portfolio in bull (bear) regimes. Relative Spread is the difference between bull relative returns and bear relative returns. Conditional ratio is defined as follows: raw ratio = abs(bull relative return - bear relative return) / (bull relative return + bear relative return) and conditional ratio = k * exp(ratio) / exp(1 + ratio) - k/2 where k = 4. When the raw ratio is negative the conditional ratio is set at 2.*

Last 15 Years, US region

From 2004-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	8.89%	7.53%	8.44%	9.61%	18.14%	12.57%	10.33%	11.34%
Volatility	18.21%	19.87%	19.21%	20.69%	20.63%	19.25%	18.93%	18.39%
Sharpe Ratio	0.42	0.31	0.37	0.40	0.82	0.58	0.48	0.55
Max Drawdown	54.63%	54.23%	49.64%	60.18%	59.22%	47.94%	60.53%	53.43%
Relative Performance								
Relative Return Over CW	-	-1.36%	-0.45%	0.72%	9.25%	3.68%	1.44%	2.45%
Tracking-Error	-	7.94%	6.10%	9.87%	9.76%	6.29%	5.10%	2.58%
Information Ratio	-	N/A	N/A	0.07	0.95	0.59	0.28	0.95
Max Relative Drawdown	-	31.48%	40.49%	32.78%	20.33%	23.01%	17.94%	6.31%
Conditional performance								
Bull Relative Return	-	2.72%	0.68%	-1.00%	8.59%	3.67%	4.07%	3.40%
Bear Relative Return	-	-4.97%	-1.49%	2.35%	8.75%	3.21%	-1.29%	1.19%
Relative Spread	-	7.69%	2.17%	3.35%	0.17%	0.46%	5.37%	2.20%
Conditional ratio	-	2.00	2.00	1.69	0.01	0.07	1.49	0.47

1. Performances and Contribution of the Factors

Last 15 Years, Dev ex-US

From 2004-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	6.22%	10.81%	6.42%	11.75%	13.38%	9.68%	6.83%	9.94%
Volatility	16.89%	18.24%	17.56%	18.32%	18.39%	17.26%	17.26%	17.02%
Sharpe Ratio	0.29	0.52	0.29	0.57	0.66	0.48	0.32	0.51
Max Drawdown	59.23%	69.98%	51.85%	64.03%	60.31%	58.60%	58.70%	60.48%
Relative Performance								
Relative Return Over CW	-	4.60%	0.20%	5.53%	7.17%	3.46%	0.62%	3.73%
Tracking-Error	-	6.65%	4.88%	6.99%	7.33%	3.57%	3.61%	1.99%
Information Ratio	-	0.69	0.04	0.79	0.98	0.97	0.17	1.87
Max Relative Drawdown	-	34.87%	35.88%	27.43%	24.29%	9.17%	11.56%	6.56%
Conditional performance								
Bull Relative Return	-	17.10%	3.13%	5.92%	5.33%	2.47%	1.71%	6.05%
Bear Relative Return	-	-3.07%	-1.54%	4.53%	7.36%	3.59%	-0.12%	1.81%
Relative Spread	-	20.18%	4.67%	1.39%	2.03%	1.11%	1.83%	4.24%
Conditional ratio	-	1.23	1.80	0.13	0.16	0.18	1.04	0.53

Naturally, we could argue that if the factor risk premia had been higher and had corresponded to their average over the long term, they could have offset the loss in performance relating to the defensive bias of long-only factor constructions. However, imagining that the risk premium does not vary actually denies the very reason for its existence. As soon as we understand that the returns of factor strategies are variable risk premia, it is necessary to accept that they cannot always offset return opportunity losses relating to non-factor fiduciary choices, like that of not seeking full exposure to the risk and return of the market.

2. Integrating the Contribution of Non-Factor Elements into the Performance of Single and Multi-Factor Indices

2. Integrating the Contribution of Non-Factor Elements into the Performance of Single and Multi-Factor Indices

In important research published in 2018 in the *Journal of Portfolio Management*,[8] Scientific Beta showed that the vast majority of long-only factor strategies were rarely neutral from a market exposure viewpoint; market betas are generally defensive and unstable. As such, Exhibit 10 shows that for the same construction of long-only indices where, instead of taking market-neutral indices, as we did previously in Exhibit 9, we take long/short dollar-neutral indices, it is clearly apparent that over the last 3 years, these indices without market-beta control have considerably underperformed their equivalents with a market-neutral market beta long/short overlay. Ultimately, both in the US and Developed ex-US regions, the long-only multi-factor assembly does not allow the broad cap-weighted index to be outperformed, as was the case previously.

Exhibit 10 – 3-year performance comparison, cap-weighted index and dollar-neutral long/short factors
The analysis is based on daily USD total returns data from 30-Jun-2016 to 30-Jun-2019 for the last 3 years. CW is the SciBeta USA Cap-Weighted index. All strategies are constructed as follow: 100% in the CW index and 100% in the corresponding equally-weighted L/S factors. L/S factors are not market neutral. The Size factor (SMB) is the return series of an equal-weighted portfolio that is long small market-cap stocks and short the top 30% stocks (large market-cap stocks) sorted on market capitalisation in descending order. The Value factor (HML) is the return series of an equal-weighted portfolio that is long for the top 30% stocks (value stocks) and short for the bottom 30% stocks (growth stocks) sorted on book-to-market value in descending order. The Momentum factor (MOM) is the return series of an equal-weighted portfolio that is long the winner stocks and short the loser stocks. The winner stocks (inversely the loser stocks) are defined as the top 30% (inversely the bottom 30%) of stocks, sorted on the past 104 weeks' compounded returns excluding the most recent month, in descending order. The Volatility factor (VOL) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low volatility stocks) and short the top 30% stocks (high volatility stocks) sorted on past volatility in descending order. The Profitability factor (PRO) is the return series of an equal-weighted portfolio that is long the top 30% stocks (high profitability stocks) and short the bottom 30% stocks (low profitability stocks) sorted on gross profitability in descending order. The Investment factor (INV) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low investment stocks) and short the top 30% stocks (high investment stocks) sorted on two year asset growth in descending order.

Last 3 years, US region

From 2016-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	14.38%	11.60%	10.10%	6.99%	13.52%	19.56%	14.56%	12.97%
Volatility	12.27%	15.07%	13.16%	17.54%	10.90%	13.63%	12.09%	11.69%
Sharpe Ratio	1.06	0.67	0.66	0.32	1.11	1.33	1.09	0.99
Max Drawdown	19.41%	28.81%	24.02%	27.06%	11.62%	17.57%	19.69%	20.00%
Relative Performance								
Relative Return Over CW	-	-2.78%	-4.28%	-7.38%	-0.86%	5.18%	0.19%	-1.40%
Tracking-Error	-	8.25%	5.78%	10.09%	10.74%	5.54%	4.13%	2.16%
Information Ratio	-	N/A	N/A	N/A	N/A	0.94	0.05	N/A
Max Relative Drawdown	-	21.52%	22.12%	25.30%	21.09%	8.68%	7.71%	4.98%

8 - Amenc, N., F. Goltz and A. Lodh, "Mind the Gap: On the Importance of Understanding and Controlling Market Risk in Smart Beta Strategies," Quantitative Special Issue 2018, *Journal of Portfolio Management*.

2. Integrating the Contribution of Non-Factor Elements into the Performance of Single and Multi-Factor Indices

Last 3 years, Dev ex-US

From 2016-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	9.57%	9.41%	9.73%	5.97%	7.49%	9.34%	8.50%	8.55%
Volatility	9.58%	9.32%	12.13%	11.86%	8.61%	9.78%	10.26%	8.95%
Sharpe Ratio	0.85	0.86	0.69	0.38	0.70	0.81	0.69	0.80
Max Drawdown	20.58%	22.91%	24.67%	23.05%	14.15%	19.44%	23.28%	19.78%
Relative Performance								
Relative Return Over CW	-	-0.16%	0.16%	-3.60%	-2.09%	-0.23%	-1.07%	-1.02%
Tracking-Error	-	4.51%	5.65%	7.32%	7.49%	3.85%	3.25%	1.72%
Information Ratio	-	N/A	0.03	N/A	N/A	N/A	N/A	N/A
Max Relative Drawdown	-	5.52%	17.41%	20.48%	22.42%	6.68%	8.45%	4.87%

It is therefore indeed the uncontrolled market conditionality of factors that, in a context of strong bull markets over the last 3 years, led to disappointing performance, and not the choice of factors or the traditional proxies that represent them. Exhibit 11, which compares the conditional performances of dollar-neutral long/short factors over 15 years illustrates this point well. It is easy to observe that in a context of strong bull markets, particularly in the US, the poor conditionality of dollar-neutral long/short was highly penalising compared to the market-neutral version.

Exhibit 11 – 15-year performance comparison, cap-weighted index and dollar-neutral long/short factors
*The analysis is based on daily USD total returns data from 30-Jun-2004 to 30-Jun-2019 for the last 15 years. CW is the SciBeta USA Cap-Weighted index. All strategies are constructed as follow: 100% in the CW index and 100% in the corresponding equally-weighted L/S factors. L/S factors are not market neutral. The Size factor (SMB) is the return series of an equal-weighted portfolio that is long small market-cap stocks and short the top 30% stocks (large market-cap stocks) sorted on market capitalisation in descending order. The Value factor (HML) is the return series of an equal-weighted portfolio that is long for the top 30% stocks (value stocks) and short for the bottom 30% stocks (growth stocks) sorted on book-to-market value in descending order. The Momentum factor (MOM) is the return series of an equal-weighted portfolio that is long the winner stocks and short the loser stocks. The winner stocks (inversely the loser stocks) are defined as the top 30% (inversely the bottom 30%) of stocks, sorted on the past 104 weeks' compounded returns excluding the most recent month, in descending order. The Volatility factor (VOL) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low volatility stocks) and short the top 30% stocks (high volatility stocks) sorted on past volatility in descending order. The Profitability factor (PRO) is the return series of an equal-weighted portfolio that is long the top 30% stocks (high profitability stocks) and short the bottom 30% stocks (low profitability stocks) sorted on gross profitability in descending order. The Investment factor (INV) is the return series of an equal-weighted portfolio that is long the bottom 30% stocks (low investment stocks) and short the top 30% stocks (high investment stocks) sorted on two year asset growth in descending order. Bull and bear markets are defined based on the CW index monthly returns. Positive (negative) monthly CW returns define bull (bear) regimes. Bull (Bear) relative returns is the relative return over the CW index of the portfolio in bull (bear) regimes. Relative Spread is the difference between bull relative returns and bear relative returns. Conditional ratio is defined as follows: raw ratio = abs(bull relative return - bear relative return) / (bull relative return + bear relative return) and conditional ratio = k * exp(ratio) / exp(1 + ratio) - k/2 where k = 4. When the raw ratio is negative the conditional ratio is set at 2.*

Last 15 Years, US region

From 2004-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	8.89%	9.44%	9.98%	8.21%	10.24%	11.56%	10.45%	10.49%
Volatility	18.21%	23.61%	21.28%	20.62%	13.11%	17.45%	16.97%	16.55%
Sharpe Ratio	0.42	0.34	0.41	0.33	0.68	0.59	0.54	0.55
Max Drawdown	54.63%	60.40%	55.49%	52.05%	33.80%	41.84%	53.68%	46.69%

A Scientific Beta Publication — What Really Explains the Poor Performance of Factor Strategies over the Last 3 years? — September 2019

2. Integrating the Contribution of Non-Factor Elements into the Performance of Single and Multi-Factor Indices

Relative Performance								
Relative Return Over CW	-	0.55%	1.09%	-0.68%	1.35%	2.67%	1.56%	1.60%
Tracking-Error	-	10.10%	7.14%	12.97%	15.12%	6.76%	6.25%	3.62%
Information Ratio	-	0.05	0.15	N/A	0.09	0.40	0.25	0.44
Max Relative Drawdown	-	26.70%	30.29%	44.77%	45.52%	19.98%	17.55%	9.66%
Conditional performance								
Bull Relative Return	-	12.88%	5.40%	-3.88%	-20.33%	-0.61%	0.87%	-0.81%
Bear Relative Return	-	-10.20%	-3.13%	2.67%	29.29%	5.73%	2.05%	3.84%
Relative Spread	-	23.09%	8.53%	6.55%	49.62%	6.34%	1.17%	4.65%
Conditional ratio	-	2.00	1.91	2.00	1.98	1.10	0.40	1.29

Last 15 Years, Dev ex-US

From 2004-06-30 to 2019-06-30, in USD	CW	Size	Value	Mom	Low Vol	High Prof	Low Inv	EW 6F
Absolute Performance								
Return	6.22%	8.39%	8.14%	9.75%	9.52%	8.25%	7.30%	8.79%
Volatility	16.89%	14.62%	20.20%	17.30%	11.72%	15.47%	16.19%	14.74%
Sharpe Ratio	0.29	0.48	0.34	0.49	0.70	0.45	0.37	0.51
Max Drawdown	59.23%	60.21%	60.07%	54.48%	34.88%	54.84%	50.07%	51.58%
Relative Performance								
Relative Return Over CW	-	2.18%	1.93%	3.54%	3.30%	2.03%	1.08%	2.57%
Tracking-Error	-	6.39%	5.99%	8.97%	11.17%	3.99%	4.35%	3.17%
Information Ratio	-	0.34	0.32	0.39	0.30	0.51	0.25	0.81
Max Relative Drawdown	-	22.06%	22.66%	35.16%	40.42%	12.89%	18.29%	9.88%
Conditional performance								
Bull Relative Return	-	-0.15%	13.88%	-2.45%	-23.95%	-5.11%	-0.21%	-3.17%
Bear Relative Return	-	3.31%	-4.97%	6.90%	23.97%	6.34%	1.72%	5.88%
Relative Spread	-	3.46%	18.85%	9.35%	47.92%	11.44%	1.93%	9.05%
Conditional ratio	-	1.00	1.57	1.57	2.00	2.00	1.13	1.86

The performance conditionality of the multi-factor indices to bull or bear market regimes had a considerable impact over the last 3 years, which can be defined as "bull" years. As seen in Exhibit 12, the US market was very bullish over the last 3 years and the defensiveness of the vast majority of multi-factor indices or solutions was therefore penalising.

Exhibit 12 – Performance of Cap-Weighted indices over the last 3 years and since June 2002
We use daily total returns in USD from 21-Jun-2002 (base date) to 30-Jun-2019 for the Scientific Beta United States, Developed and Developed Ex-US universes Cap-Weighted universes. US and Developed Ex-US performances are expressed in USD.

	SciBeta US CW	SciBeta Developed ex-USA CW
Last 3 years	14.38%	9.57%
Last 5 years	10.65%	2.79%
Last 15 years	8.89%	6.22%
Since base date	9.00%	7.09%

Conclusion: In Addition to Design Questions, Performance is a Consequence of Fiduciary Choice

Conclusion: In Addition to Design Questions, Performance is a Consequence of Fiduciary Choice

The analysis that we have conducted on the performance of factor and multi-factor portfolios has allowed us to observe that even though negative performance has been observed for some factors in recent years, it has been possible to offset this through the good performance of other factors. Overall, the factor contribution, in the strict sense, to the performance of the strategies is not negative.

The source of the poor performance therefore needs to be sought within the implementation conditions of this factor diversification in a long-only context that is quite different from market-neutral long/short factors. In the same way, for regulatory or investment governance reasons, the implementation of long-only factor strategies is rarely done with long/short factor overlays, but instead with pure long-only single or multi-factor indices or portfolios, which are therefore absolutely not long-only market-beta-neutral in the sense that the market beta of the factor sleeves is rarely equal to 1. This market beta deviation is a non-factor risk that is naturally embedded in long-only indices. It is clear that the pronounced bull market conditions of the last 3 years, notably in the US, have been unfavourable for multi-factor indices or solutions, the vast majority of which have defensive beta biases. In this context, only multi-factor indices that benefitted from a risk-control option that guaranteed alignment of the market beta with that of the reference cap-weighted index were able to significantly improve relative returns.

Naturally, taking this market variation risk into account is a fiduciary decision that falls outside of the remit of an index provider. We consider that an index provider should provide different indices that are representative of these fiduciary choices for the same factor strategy. These fiduciary choices correspond to different risk/return objectives. If the objective for example is to have lower volatility than that of the market and a pay-off that will provide better performance (protection) in bear markets than in bull markets, then the market beta adjustment should be ruled out. Conversely, if the objective is to maximise access to the equity risk premium (by accepting of course to be exposed to the full volatility of the market), then it is logical to seek a market beta of 1 for the factor strategy under consideration. As such, it makes sense to choose the index that is representative of this strategy with the Market Beta Adjustment option. These questions, which condition the risks and pay-offs of factor strategies, are of prime importance both over the long term and over shorter periods like the last 3 years. All empirical and academic studies have shown that stock picking is not a robust way to deliver risk-adjusted outperformance, so it is a shame to see it being revitalised in the form of competition for in-sample design of new factor proxies, to the detriment of giving serious thought to managing the risks of factor strategies, which, as we have seen, is what really matters.

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About Scientific Beta

About Scientific Beta

EDHEC-Risk Institute set up Scientific Beta in December 2012 as part of its policy of transferring know-how to the industry. Scientific Beta is an original initiative which aims to favour the adoption of the latest advances in "smart beta" design and implementation by the whole investment industry. Its academic origin provides the foundation for its strategy: offer, in the best economic conditions possible, the smart beta solutions that are most proven scientifically with full transparency of both the methods and the associated risks. Smart beta is an approach that deviates from the default solution for indexing or benchmarking of using market capitalisation as the sole criterion for weighting and constituent selection.

Scientific Beta considers that new forms of indices represent a major opportunity to put into practice the results of the considerable research efforts conducted over the last 30 years on portfolio construction. Although these new benchmarks may constitute better investment references than poorly-diversified cap-weighted indices, they nevertheless expose investors to new systematic and specific risk factors related to the portfolio construction model selected.

Consistent with a full control of the risks of investment in smart beta benchmarks, Scientific Beta not only provides exhaustive information on the construction methods of these new benchmarks but also enables investors to conduct the most advanced analyses of the risks of the indices in the best possible economic conditions.

Lastly, within the context of a Smart Beta 2.0 approach, Scientific Beta provides the opportunity for investors not only to measure the risks of smart beta indices, but also to choose and manage them. This new aspect in the construction of smart beta indices has led Scientific Beta to build the most extensive smart beta benchmarks platform available which currently provides access to a wide range of smart beta indices.

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